

NETWORKED UNMANNED AERIAL VEHICLE TEAMS (NUAVT)

Summary

A partnership between the NASA Ames Research Center and the NASA Dryden Flight Research Center (DFRC) explored the ability of small unmanned aircraft to support forest fire fighting using teaming behavior. The Networked UAV Teams project flight tested mission planning algorithms for multi-UAV cooperative transit, area search, and waypoint time-of-arrival that might someday allow the early detection of developing forest fires and support the gathering of images and atmospheric samples to help improve predictions of the future behavior of established fires.

Objective

The primary objective of the project was to demonstrate, in a flight environment, the potential usefulness of multiple coordinated UAVs for forest fire fighting applications. Two UAVs were launched in support of an imaginary forest fire fighting activity. The airplanes were tasked to cooperatively search for new forest fires and to gather air samples, using virtual sensors for both.

Approach

The DFRC owns and operates two APV-3 UAVs, manufactured by RnR Products of Milpitas, California. The UAVs (pictured below) have 12-foot wingspans, weigh 30 lb empty and can carry up to 25 lb of combined fuel and payload. Both UAVs are outfitted with Piccolo® (Cloud Cap Technology, Inc., Hood River, Oregon) avionics and are operated via a Cloud Cap ground control station (GCS). Software was developed by NASA to perform real-time multi-vehicle dynamic mission planning on a second ground computer interfaced with the GCS. Bird and/or (Boid) algorithms provided the UAVs with behaviors similar to flocking birds and dynamic search algorithms provided the UAVs with the ability to work cooperatively to efficiently search an area. Four-dimensional navigation control ensured that the locations of the UAVs were coordinated in space and time.



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Figure 1. The NASA DFRC APV-3s in flight.

Results

Figure 2 below the ground tracks for both UAVs using Boid algorithms to flock together while traveling from the lower-right corner of the flight test range to the upper left. The airplanes successfully avoided two virtual obstacles that were placed in their paths and arrived at their destination waypoints.

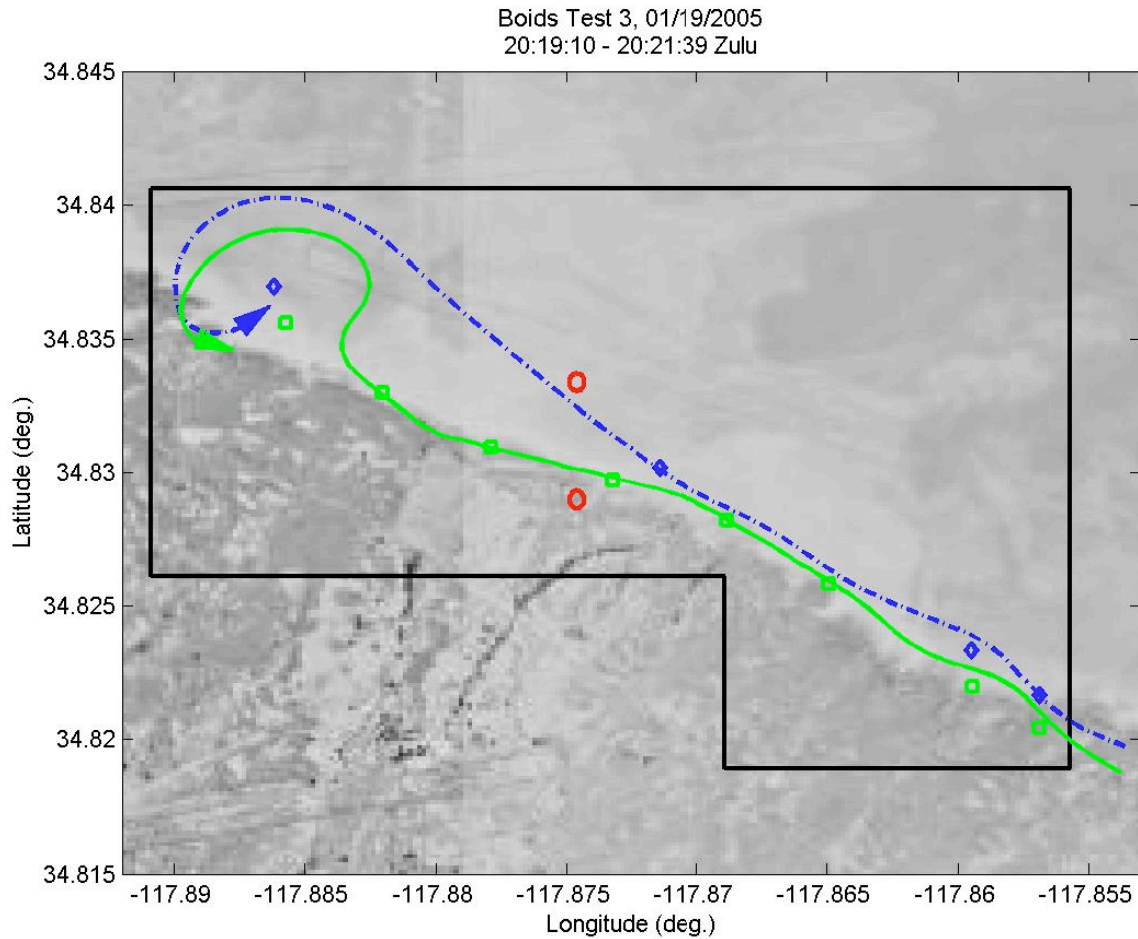


Figure 2. Boids test ground track.

Results from a cooperative search flight test are shown in figure 3. Initial mission planning divided the search area evenly between both aircraft. Soon after the search began, one of the aircraft located a virtual forest fire and entered an orbit to gather more information. The second aircraft was then retasked and completed the remaining unsearched waypoints.

Replan Test: Replanned Search, 01/20/2005
21:06:28 - 21:17:12 Zulu

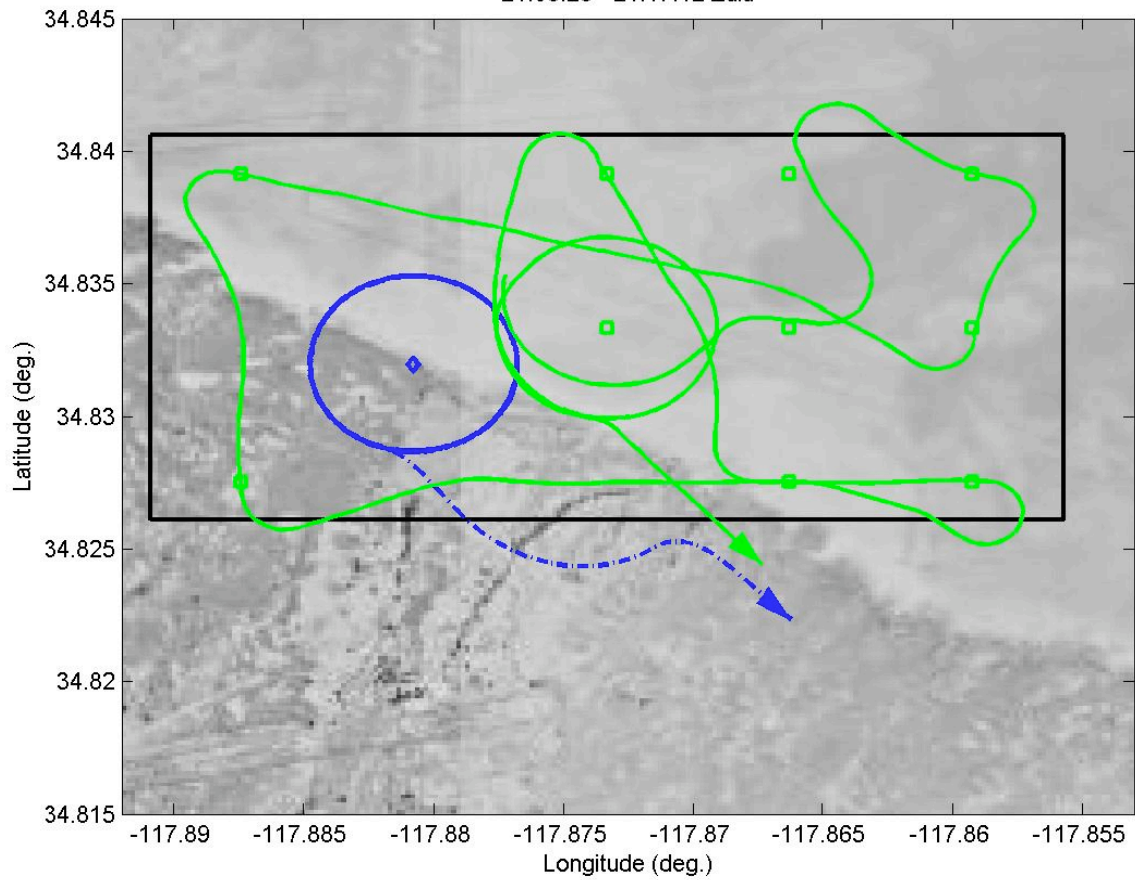


Figure 3. Replan test ground track.

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